

WHAT IS CLAIMED IS:

1. A method of embossing an absorbent web with an undulatory structure extending in the machine direction comprising:
 - 5 providing a web with a plurality of ridges extending in its machine direction to an embossing station;

wherein the plurality of ridges extending in the machine direction of the web occur at a frequency, F , across the web; and
 - 10 embossing the web at the embossing station between a first and second embossing roll, at least one of which rolls is provided with a plurality of embossing elements and wherein the rolls are thereby configured to define therebetween a plurality of embossing nips;
 - 15 wherein at least a portion of the nips defined by the embossing rolls are substantially oriented in a cross-machine direction with respect to the web and have a cross direction length, L , wherein the product $F \times L$ is from about 0.1 to about 5.
- 20 2. The method according to Claim 1, wherein the product $F \times L$ is from about 0.2 to about 3.
- 25 3. The method according to Claim 2, wherein the product $F \times L$ is from about 0.3 to about 2.
4. The method according to Claim 2, wherein the product $F \times L$ is from about 0.5 to about 1.5.

5. The method according to Claim 1, wherein substantially all of the nips defined by the embossing rolls are substantially oriented in the cross direction.
6. The method according to Claim 1, wherein the embossing nips oriented in the cross direction comprise perforate embossing nips.
7. The method according to Claim 1, wherein at least a portion of the embossing elements are male elements that are substantially oval shaped.
8. The method according to Claim 1, wherein at least a portion of the embossing elements are male elements that are substantially hexagonal shaped.
9. The method according to Claim 1, wherein at least a portion of the embossing elements are male elements that are substantially rectangular shaped.
10. The method according to Claim 1, wherein the cross-machine direction oriented nips defined by the embossing rolls are at an angle of from about 60° to about 120° from the machine direction.
11. The method according to Claim 1, wherein the cross-machine direction oriented nips defined by the embossing rolls are at an angle of from about 85° to about 95° from the machine direction.
12. The method according to Claim 1, wherein at least a portion of the embossing elements are male elements having a height of at least about 15 mils.
13. The method according to Claim 12, wherein at least a portion of the embossing elements are male elements having a height of at least about 30 mils.

14. The method according to Claim 1, wherein the cross-machine direction oriented nips are defined by embossing elements which are in full-step alignment.
15. The method according to Claim 1, wherein the cross-machine direction oriented nips are defined by embossing elements which are in half-step alignment.
16. The method according to Claim 1, wherein the cross-machine direction oriented nips are defined by embossing elements which are in quarter-step alignment.
- 10 17. The method according to Claim 1, wherein the cross-direction oriented embossing nips are defined by embossing elements on opposed embossing rolls and where the embossing element engagement is at least about 15 mils.
- 15 18. The method according to Claim 17, wherein the cross-direction oriented embossing nips are defined by embossing elements on opposed embossing rolls and where the embossing element engagement is from about 16 to about 32 mils.
19. The method according to Claim 1, wherein the cross-machine direction oriented nips are defined by embossing elements which have angled sidewalls, wherein the sidewalls have an angle of less than about 20°.
- 20 20. The method according to Claim 1, wherein at least a portion of the embossing elements have a height of at least about 30 mils wherein the cross-direction oriented embossing nips are defined by embossing elements on opposed embossing rolls and where the engagement of opposed elements is at least about 15 mils.
- 25 21. The method according to Claim 1, wherein at least a portion of the embossing elements have a height of at least about 30 mils wherein the cross-direction

oriented embossing nips are defined by embossing elements on opposed embossing rolls and where the engagement of opposed elements is at least about 24 mils.

- 5 22. The method according to Claim 1, wherein the web is a creped web prepared with an undulatory creping blade, having a biaxially undulatory structure with crepe bars extending in the cross direction and ridges extending in the machine direction.
- 10 23. The method according to Claim 22, wherein the web has from about 4 to about 50 ridges per inch extending in the machine direction.
24. The method according to Claim 23, wherein the web has from about 8 to about 25 ridges per inch extending in the machine direction.
- 15 25. The method according to Claim 24, wherein the web has from about 10 to about 16 ridges per inch extending in the machine direction.
26. The method according to Claim 21, wherein the web has from about 4 to about 50 ridges per inch extending in the machine direction and from about 10 to about 150 crepe bars per inch extending in the cross-machine direction of the web.
- 20 27. The method according to Claim 1, wherein the embossing nips oriented in the cross-machine direction comprise perforate embossing nips and the embossing step is operative to reduce the dry tensile ratio of the web.
- 25 28. The method according to Claim 1, wherein the embossing nips comprise perforate embossing nips and the process of embossing the web is operative to reduce the wet tensile ratio of the web.

29. The method according to Claim 1, wherein at least a portion of the embossing nips are perforate embossing nips and wherein the process of embossing the web is operative to increase the transluminance ratio of the web.
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30. The method according to Claim 1, operative to reduce the MD dry tensile strength of the web by less than about 15%.
31. The method according to Claim 30, operative to reduce the MD dry tensile strength of the web by at least about 10%.
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32. The method according to Claim 1, operative to reduce the MD dry tensile strength of the web by from about 35% to about 65%.
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33. The method according to Claim 1, operative to reduce the CD dry tensile strength by less than about 30%.
34. The method according to Claim 32, operative to reduce the CD dry tensile strength by less than about 25%.
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35. The method according to Claim 33, operative to reduce the CD dry tensile strength by less than about 20%.
36. The method according to Claim 34, operative to reduce the CD dry tensile strength by less than about 15%.
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37. The method according to Claim 1, operative to impart a caliper gain of at least about 15%.

38. The method according to Claim 36, operative to impart a caliper gain of at least about 20%.

5 39. The method according to Claim 37, operative to impart a caliper gain of at least about 25%.

40. The method according to Claim 38, operative to impart a caliper gain of at least about 30%.

10 41. The method according to Claim 39, operative to impart a caliper gain of at least about 40%.

42. A method of embossing an absorbent web with an undulatory structure extending in the machine direction comprising:

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providing a web with a plurality of ridges extending in its machine direction to an embossing station;

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wherein the plurality of ridges extending the machine direction of the web occur at a frequency, F , across the web; and

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embossing the web at the embossing station between a first and second embossing roll, at least one of which rolls is provided with a plurality of embossing elements and the rolls are thereby configured to define therebetween a plurality of embossing nips,

wherein at least a portion of the nips defined by the embossing rolls are substantially oriented in the cross-machine direction, having a cross direction length, L , and are laterally spaced at a

distance, **D**, with the proviso that: (a) the product **F x L** is between about 0.1 and about 5 or (b) the product **F x D** is between about 0.1 and about 5.

- 5 43. The method according to Claim 42, wherein the product **F x L** is from about 0.2 to about 3.
44. The method according to Claim 42, wherein the product **F x D** is from about 0.2 to about 3.
- 10 45. The method according to Claim 43, wherein substantially all of the nips defined by the embossing rolls are substantially oriented in the cross-machine direction.
46. The method according to Claim 45, wherein the embossing nips oriented in the cross-machine direction comprise perforate embossing nips.
- 15 47. The method according to Claim 46, wherein at least a portion of the embossing elements are male elements that are substantially oval shaped.
- 20 48. The method according to Claim 42, wherein the web is a creped web prepared with an undulatory creping blade, having a biaxially undulatory structure with crepe bars extending in the cross-machine direction and ridges extending in the machine direction.
- 25 49. The method according to Claim 48, wherein the web has from about 4 to about 50 ridges per inch extending in the machine direction.
50. The method according to Claim 49, wherein the web has from about 8 to about 50 ridges per inch extending in the machine direction.

51. The method according to Claim 50, wherein the web has from about 10 to about 16 ridges per inch extending in the machine direction.
- 5 52. The method according to Claim 48, wherein the web has from about 4 to about 50 ridges per inch extending in the machine direction and from about 10 to about 150 crepe bars per inch extending in the cross-machine direction.
- 10 53. The method according to Claim 42, wherein the embossing nips comprise perforate embossing nips and wherein the process of embossing the web is operative to reduce the dry tensile ratio of the web.
- 15 54. The method according to Claim 42, wherein the embossing nips comprise perforate embossing nips and wherein the process of embossing the web is operative to reduce the wet tensile ratio of the web.
- 20 55. The method according to Claim 42, wherein the embossing nips comprise perforate embossing nips and the process of embossing the web is operative to increase the transluminance ratio of the web.
- 25 56. An embossed absorbent web having an undulatory structure and a plurality of perforate embossments wherein the undulatory structure of the web comprises a plurality of ridges extending in the machine direction of the web occurring at a frequency, F , across the web and at least a portion of the perforate embossments:
- (i) extend substantially in the cross-machine direction; and
 - (ii) the perforate embossments extending in the cross-machine direction extend in the cross-machine direction a distance, L' ; and

(iii) the perforate embossments extending in the cross-machine direction are laterally spaced from adjacent perforate embossments extending in the cross-machine direction a distance, D' ;

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with the proviso that: (a) the product $F \times L'$ is between about 0.1 and about 5 or (b) the product $F \times D'$ is between about 0.1 and about 5.

57. The embossed absorbent web according to Claim 56, wherein the web has a
10 biaxially undulatory structure.

58. The embossed absorbent web according to Claim 57, wherein the web has a dry tensile ratio of less than about 1.2.

15 59. The embossed absorbent web according to Claim 57, wherein the web has a transluminance ratio of at least about 1.005.

60. The embossed absorbent web according to Claim 59, having a transluminance ratio of at least about 1.01.

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61. The embossed absorbent web according to Claim 56, wherein the product $F \times L'$ is from about 0.2 to about 3.

62. The embossed absorbent web according to Claim 61, wherein the product $F \times L'$
25 is from about 0.3 to about 2.

63. The embossed absorbent web according to Claim 56, wherein the product $F \times D'$ is from about 0.2 to about 3.

64. The embossed absorbent web according to Claim 56, wherein substantially all of the embossments are substantially oriented in the cross-machine direction.
- 5 65. The embossed absorbent web according to Claim 57, wherein the web has from about 4 to about 50 ridges per inch extending in the machine direction.
66. The embossed absorbent web according to Claim 65, wherein the web has from about 8 to about 25 ridges per inch extending in the machine direction.
- 10 67. The embossed absorbent web according to Claim 66, wherein the web has from about 10 to about 16 ridges per inch extending in the machine direction.
- 15 68. The embossed absorbent sheet according to Claim 67, wherein the web has from about 10 to about 50 ridges per inch extending in the machine direction and from about 10 to about 150 crepe bars per inch extending in the cross-machine direction.